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(54) Apparatus and method for loading workpieces in a processing system.

(57) A workpiece loading interface is included within a workpiece processing system which processes workpieces, typically wafers, in a vacuum. The workpiece loading interface includes two separate chambers (8, 9). Each chamber may be separately pumped down. Thus, while a first cassette (16) of wafers (10), from a first chamber (8) is being accessed, a second cassette of wafers (17) may be loaded in the second chamber (9) and the second chamber pumped down. Each chamber (8, 9) is designed to minimize intrusion to a clean room. Thus a door to each chamber has a mechanism which, when opening the door, first moves the door slightly away from an opening in the chamber and then the door is moved down parallel to the chamber. After the door is opened, a cassette of wafers is lowered through the opening in a motion much like a drawbridge. The cassette (16, 17) may be pivoted within the chamber (8, 9) when the position from which wafers are accessed from the cassette differs from the position from which the cassette is lowered out of the chamber.

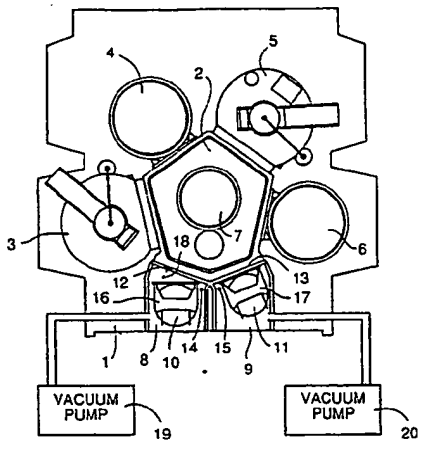


Figure 1

EP 0 452 939 A1

The invention refers to an apparatus and a method for loading workpieces in a workpiece processing system.

Semiconductor processing equipment often has a plurality of chambers in which processing occurs. Arm assemblies or other robotic devices are generally used to move workpieces, generally wafers from a wafer queuing station to various chambers for processing. When the processing is finished the wafer is returned to the queuing station. For an example of prior art processing equipment, see U.S. Patent Number 4,715,921 issued to Maher et al. for a Quad Processor.

Semiconductor processing is typically done in a vacuum. Therefore, a wafer queuing station into which is placed a cassette of wafers to be processed must be pumped down before the wafers may be accessed. This significantly increases the time the semiconductor processing equipment is idle while waiting for a cassette of processed wafers to be exchanged for a cassette of unprocessed wafers and subsequent pumping down of the wafer queuing station.

The invention intends to overcome this and similar problems by providing in a workpiece processing system a workpiece loading interface according to independent claims 1 and 6, and a method according to independent claim 8. Further advantageous features and aspects of the invention are evident from the dependent claims, the description and the drawings. The claims are intended to be understood as a first non-limiting approach of defining the invention in general terms.

The invention therefore provides a dual cassette load lock. The invention further provides a front end loading interface used in the loading of workpieces in semiconductor processing equipment.

In accordance with a preferred embodiment of the present invention, a workpiece loading interface is presented for inclusion within a workpiece processing system. The workpiece loading interface includes two separate chambers. Each chamber may be separately pumped down. Thus, while a first cassette of workpieces, typically wafers, from a first chamber are being accessed, a second cassette of wafers may be loaded in the second chamber and the second chamber may then be pumped down. This can significantly increase throughput of wafers through the workpiece processing system.

In the preferred embodiment, each chamber is designed to minimize intrusion to a clean room. Thus a door to each chamber has a mechanism which, when opening the door, first moves the door slightly away from an opening in the chamber and then the door is moved down parallel to the chamber. After the door is opened, a cassette of wafers is lowered through the opening in a motion much like a drawbridge. The cassette of wafers is on a support with no side panels, facilitating the replacement of a cassette of processed wafers with a cassette of unprocessed wafers by an automated device. The cassette may be pivoted within the chamber when the position from which wafers are accessed from the cassette differs from the position from which the cassette is lowered out of the chamber.

Figure 1 shows a top view of a block diagram of semiconductor processing equipment which includes two cassette load locks in accordance with the preferred embodiment of the present invention.

Figure 2 shows a block diagram of a load lock which is part of the semiconductor processing equipment shown in Figure 1 in accordance with the preferred embodiment of the present invention.

Figure 3 shows a second block diagram of the load lock shown in Figure 2 in accordance with the preferred embodiment of the present invention.

Figure 4 shows another block diagram of the load lock shown in Figure 2 in accordance with the preferred embodiment of the present invention.

Figure 5 is a block diagram of a cassette wafer holder in a position extended out of the load lock shown in Figure 2 in accordance with the preferred embodiment of the present invention.

Figure 6 is a block diagram of the cassette wafer holder shown in Figure 5 in an upright position within the load lock shown in Figure 2 in accordance with the preferred embodiment of the present invention.

In Figure 1, a top view of semiconductor processing equipment 1 is shown. Semiconductor processing equipment 1 may be used, for example, for etching wafers.

Semiconductor processing equipment 1, includes, for example, a processing chamber 3, a processing chamber 4, a processing chamber 5 and a processing chamber 6. A central chamber 2 may be used to temporarily store wafers on robotic equipment 7 when wafers are being moved to or from various of the processing chambers.

Semiconductor processing equipment 1 also includes dual cassette load locks. In chamber 8, a wafer cassette or tray 16 holds wafers 10. In chamber 9, a wafer cassette or tray 17 holds wafers 11. Wafer tray 17 pivots around a pivot point 15. When wafers 11 from tray 17 are accessed by semiconductor processing equipment 1 for processing, wafer tray 17 is flush against a gate 13, as shown, and easily accessed by robotic equipment 7 for transportation into central chamber 2. When wafer tray 17 is ready to be removed from chamber 9, wafer tray 17 is pivoted back from gate 13 in preparation for the opening of chamber 9 and removal of wafer tray 17.

Similarly, wafer tray 16 pivots around a pivot point 14. When wafers 10 from tray 16 are acces-

sed by semiconductor processing equipment 1 for processing, wafer tray 16 is flush against a gate 12 and easily accessed by robotic equipment 7 for transportation into central chamber 2. When wafer tray 16 is ready to be removed from chamber 8, wafer tray 16 may be pivoted back an angle 18 from gate 12, as shown, in preparation for the opening of chamber 8 and removal of wafer tray 16. In the preferred embodiment, angle 18 is about twenty-one degrees.

Chamber 8 and chamber 9 may be separately and individually pumped down. A vacuum pump 19 is able to provide a vacuum in chamber 8. A vacuum pump 20 is able to provide a vacuum in chamber 9. In Figure 1, vacuum pumps 19 and 20 are shown in schematic form. Typically pumps 19 and 20 would reside within semiconductor processing equipment 1. Further, while Figure 1 shows two separate pumps, a single pump could be used to separately and individually pump down chamber 8 and chamber 9.

Figure 2 shows a simplified block diagram front view of wafer chamber 8. In the preferred embodiment, the volume of chamber 8 is 46 liters. A door 21 is shown in a closed position. Door 21 includes an observation window 22. Door 21 is opened and closed using a pneumatic actuator within a rod 24. Magnets in the pneumatic actuator interface attract an outer ring 26. Outer ring 26 is connected to door 21 through an assembly 23.

Figure 3 shows door 21 lowered into an open position. An opening 25, for example may be fifteen inches high and ten and one half inches * wide. By opening down, the intrusion of door 21 into a clean room may be minimized. In the preferred embodiment the total intrusion is about one inch.

Once door 21 is lowered, wafer tray 16, on a support structure 43, may then be lowered out of chamber 8, much like a draw bridge is lowered at a castle entrance. Wafer tray 16 may then be removed and a new wafer tray placed upon support structure 43. Support structure 43 is designed with a hollow bottom so that when door 21 is opened and wafer tray 16 is lowered, a laminar airflow may sweep downward through wafers 10.

In Figure 4, additional detail of the mechanism which controls the opening and shutting door 21 is shown. A side panel 31 of door 21 is connected to a carriage 30 by a spring 34, a link 36 and a link 35. As controlled by the pneumatic actuator within rod 24, door 21 travels up and down parallel to a rail 50. When being closed, door 21 is stopped by an abutment 32; however, carriage 30 continues upward, expanding spring 34, until a gap 33 is completely closed. While carriage 30 continues moving upward, a pivot 39 connected to link 36, and a pivot 40 connected to link 35 continue moving upward. However a pivot 37 connected to link 36 and a pivot 38 connected to link 35 cause door 21 to move towards carriage 30. Therefore, as gap 33 is closed, links 35 and 36 translate the upward motion of carriage 30 into horizontal motion of door 21. Door 21 is thus brought snug against, and hence seals chamber 8.

When door 21 is opened, spring 34 compresses causing gap 33 to reappear and links 35 and 36 to straighten, thus moving door 21 horizontally away from chamber 8.

Figures 5 and 6 show a block diagram of one possible implementation of an assembly for guiding the lowering and raising of support structure 43. In Figure 5, support structure 43 and cassette 16 are shown lowered out of chamber 8. A roller 44 connected to support structure 43 is shown resting on an extension of a cam containing slot 46 within chamber 8. A roller 45, also connected to support structure 43, is shown at a first end of a slot track 46.

In Figure 6, support structure 43 and cassette 16 are shown in the upright position within chamber 8. In this position, wafers 10 are horizontal and are stacked so that they are ready to be accessed by semiconductor processing equipment 1. When support structure 43 and cassette 16 are in the upright position, roller 45 is rolled to a second end of slot track 46 and roller 44 rests against a stop 49. Stop 49 is an extension of the cam which contains slot 46.

Claims

1. In a workpiece processing system, especially for processing workpieces in a vacuum, a workpiece loading interface comprising:

   a first chamber (8) for receiving workpieces (10) and forwarding the workpieces to the workpiece processing system (2 to 6) for processing;

   a second chamber (9) for receiving workpieces (11) and forwarding the workpieces to the workpiece processing system (2 to 6) for processing;

   pump means (19, 20) for separately producing a vacuum in the first (8) and/or second chamber (9), the pump means preferably comprising

   a first pump means (19) for separately producing a vacuum in the first chamber (8) apart from the second chamber (9); and,

   a second pump means (20) for separately producing a vacuum in the second chamber

* 1 inch = 2.54 cm

(9) apart from the first chamber (8).

2. A workpiece processing system as in claim 1 wherein the workpieces (10, 11) are wafers and are held in the first chamber (8) and in the second chamber (9) in cassettes (16, 17).

3. A workpiece processing system as in claim 1 or 2, wherein the workpiece loading interface additionally comprises:

a first cassette lowering means (43 to 49) for lowering a first cassette (16) of workpieces (10) out of the first chamber (8) in a drawbridge motion; and/or

a second cassette lowering means (43 to 49) for lowering a second cassette (17) of workpieces (11) out of the second chamber (9) in a drawbridge motion.

4. A workpieces processing system as in one of the preceding claims, wherein the workpiece loading interface additionally comprises:

a first pivot means (14) for pivoting the first cassette (16) between a first position in which the first cassette (16) may be lowered by a first cassette lowering means (43 to 49), and a second position from which workpieces (10) from the first cassette (16) may be accessed by the workpiece processing system (2 to 6); and/or

a second pivot means (15) for pivoting the second cassette (17) between a first position in which the second cassette (17) may be lowered by a second cassette lowering means (43 to 49), and a second position from which workpieces (11) from the second cassette (17) may be accessed by the workpiece processing system (2 to 6).

5. A workpiece processing system as in one of the preceding claims, wherein the first chamber (8) and/or the second chamber (9) includes:

an opening (25) through which a workpiece may be lowered;

a door (21) which, when shut, covers and seals the opening (25); and

door mechanism means (30 to 40, 50) for, when opening the door (21), first moving the door slightly away from the opening (25) and then moving the door (21) down parallel to the chamber.

6. In a workpiece processing system, especially according to one of the preceding claims, a workpiece loading interface comprising:

at least one chamber (8, 9) for receiving workpieces (10, 11) held in a cassette (16, 17) and forwarding the workpieces to the workpiece processing system (2 to 6) for processing;

a cassette lowering means (43 to 49) for lowering the cassette (16, 17) of workpieces out of the first chamber (8, 9) in a drawbridge motion; and

a pivot means (14, 15) for pivoting the cassette (16, 17) between a first position in which the cassette may be lowered by the cassette lowering means (43 to 49), and a second position from which workpieces from the cassette may be accessed by the workpiece processing system (2 to 6).

7. A workpiece processing system as in claim 6, wherein the chamber (8, 9) includes:

an opening (25) through which the cassette may be lowered;

a door (21) which, when shut, covers and seals the opening (25); and

door mechanism means (30 to 40, 50) for, when opening the door (21), first moving the door (21) slightly away from the opening (25) and then moving the door (21) down parallel to the chamber.

8. A method for loading workpieces into a workpiece processing system, especially for processing workpieces in a vacuum, the method comprising the following steps performed by the workpiece processing system:

a) receiving the first workpieces into a first chamber;

b) pumping down the first chamber to create a vacuum in the first chamber;

c) processing the first workpieces;

d) receiving second workpieces into a second chamber;

e) pumping down the second chamber to create a vacuum in the second chamber; and,

f) processing the second workpieces;

the workpieces preferably being wafers and are held in cassettes.

9. A method as in claim 8, wherein step c) and step f) are not performed simultaneously.

10. A method as in claim 8 or 9, wherein step a) and step d) comprise the substep of:

i) raising a cassette of wafers into a chamber in a drawbridge motion, and/or

wherein step b) and step e) comprise the substeps of:

i) moving a door upward parallel to a chamber; and,

ii) moving a door tight against the chamber,

sealing the chamber.

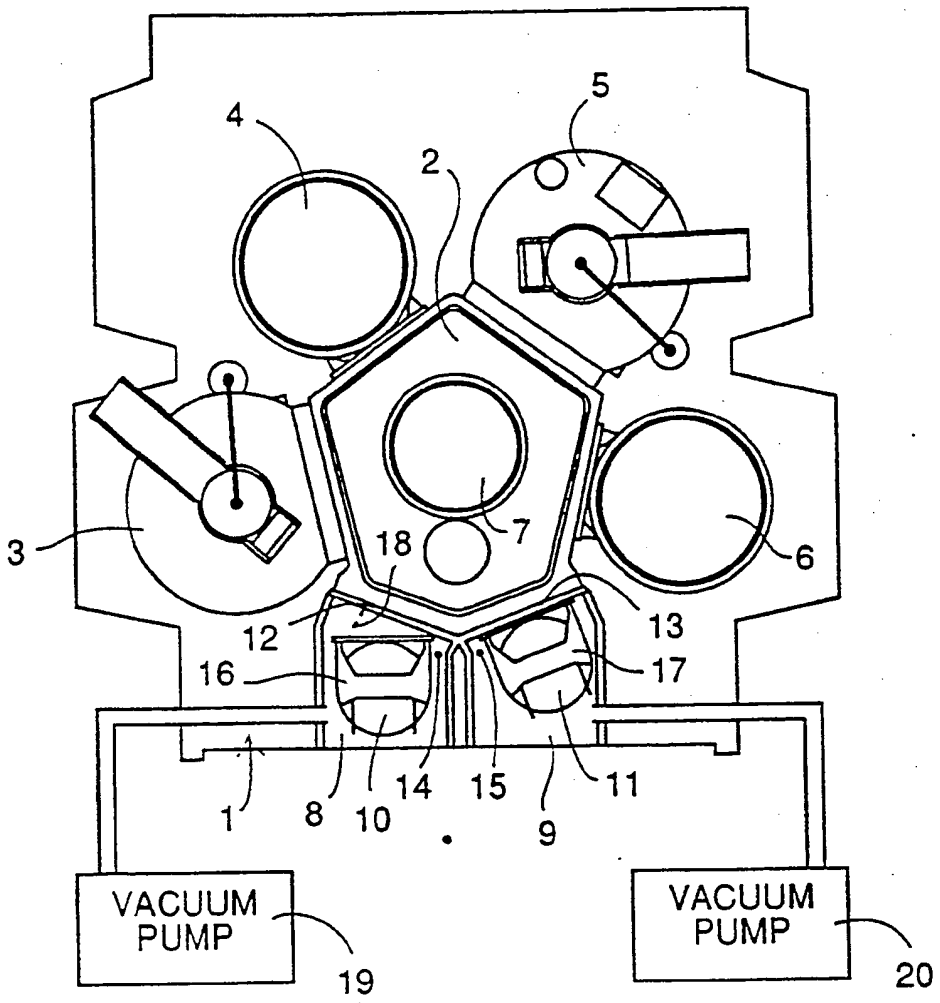


Figure 1

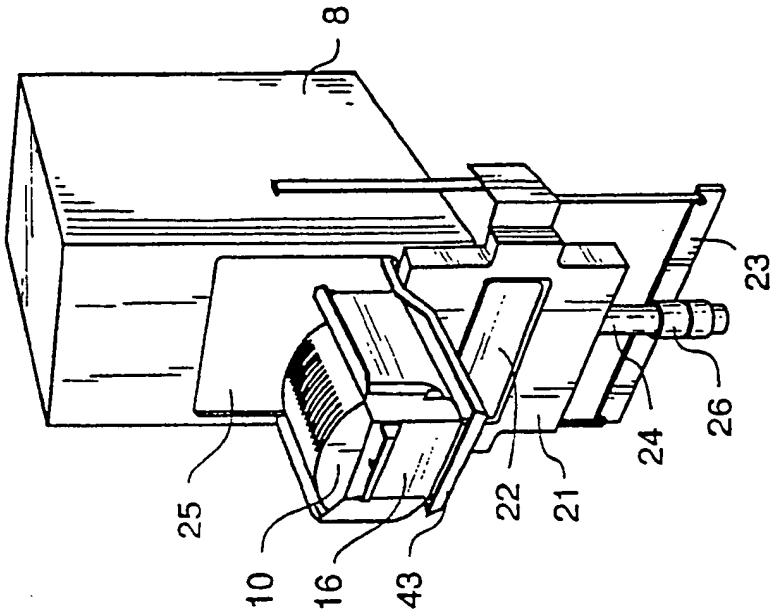


Figure 3

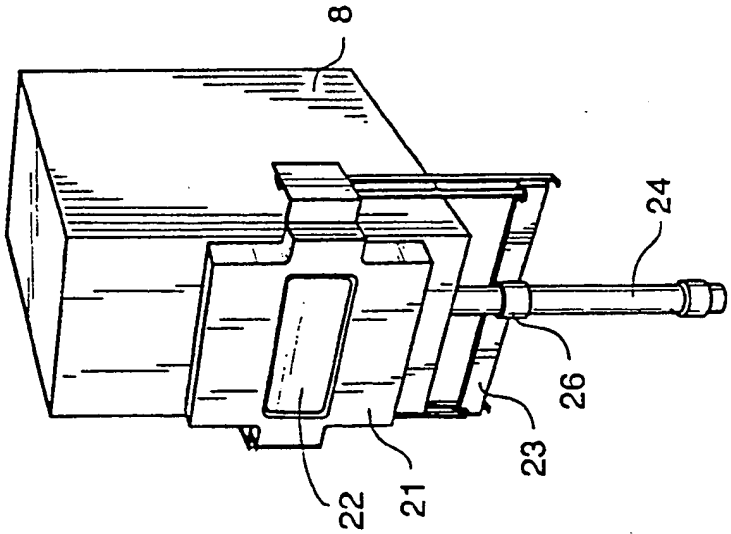
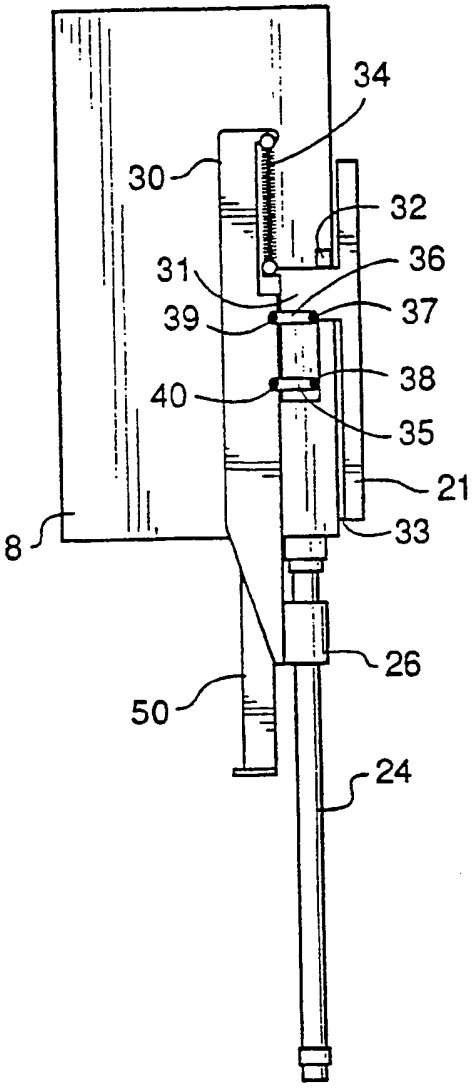


Figure 2

Figure 4



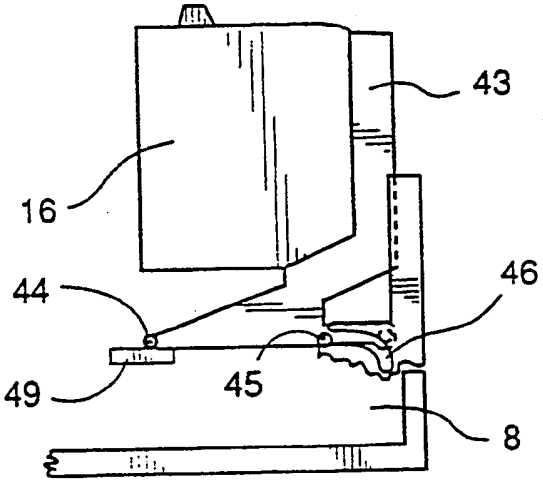


Figure 6

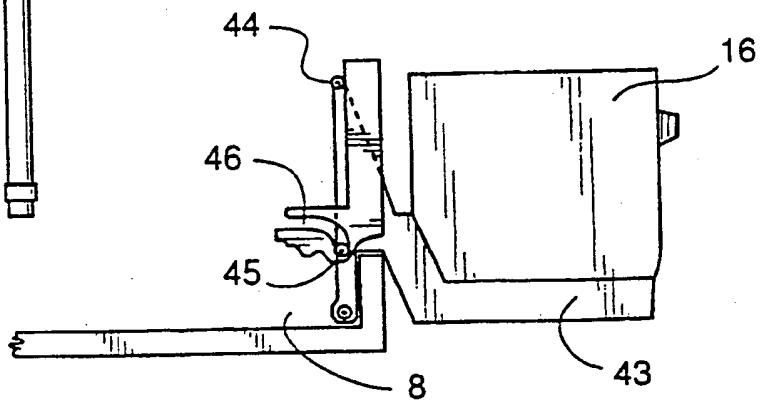


Figure 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 10 6247

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,A	US-A-4 891 488 (DAVIS) * column 20, line 63 - column 23, line 55; figures 5A, 5B *	1,2,8,9,6	H 01 L 21/00
A	US-A-4 640 223 (DOZIER) * column 7, lines 13 - 55; figures 2, 10-12 *	1,5,7,10	
D,A	US-A-4 715 921 (MAHER) * abstract; figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 L

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	09 July 91	RIEUTORT A.S.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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